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THE NEW DEPARTURE IN GEOGRAPHY

By CHARLES R. DRYER,

State Normal School, Terre Haute, Ind.

(Concluded from January.)

6. *The Biogeography Stage,* like its predecessor, was officially inaugurated, and its initiative is again due to Davis, the father and sponsor of specialized physiography in the schools. His vice-presidential address at the St. Louis meeting of the A. A. A. S. in 1904, was a brief plea for the organization of what he ventured to call ontography, or the life phase of geography, for geography defined as a study of physical controls and organic responses, a definition which he subsequently elaborated with characteristic fullness and force*, and which has been very generally accepted in this country. Like all similar movements, this involves advance along many lines.

First. Progress involves the elimination from geography of pure physics, astronomy, geology, history and all matter which is not essential for the solution of the main problem. There is at present a tendency in some localities to revert to an earlier stage and to use geography as a name for an introduction to general science. The stronghold of this movement is in the state of New York, where the Regents' Syllabus and examinations force upon the schools a geography of this type, for which the recent textbook of Arey and his colleagues was specially written. This seems to me a distinct step backward and I cannot believe that it will prevail.

Second. The forward movement involves a rigorous sifting of geomorphology and meteorology down to what is essential as a basis for biogeography. Many topics and details of great interest to physiography in the university must be omitted or briefly treated. Mention of even the names of planets and of geological eras and periods, terrestrial magnetism, the nebular and meteoric hypotheses, eclipses, electrical and optical phenomena, the theory of the tides and special studies of minerals and rocks may be eliminated. Volcanoes, geysers, earthquakes, caverns, coral

*Geographical Journal, Vol. 22, p. 413.

Proceedings American Philosophical Society, Vol. 41, p. 235. First Year Book of National Society for the Scientific Study of Education, Part II.

islands, the fancy stock in trade of the old geographical wonder book, may be briefly treated. Multiplied species of rivers and lakes and many refinements of classification and of the phenomena of the physiographic cycle may be safely omitted. Extended discussion of ocean temperatures and salinity and of deep sea deposits can be dispensed with. Coasts, harbors and currents are more important than the theory of the tides. The chapters on the atmosphere are to contain as little meteorology and as much climatology as possible.

Third. Modern research shows that climate is a much more important factor than relief in determining the distribution and association of plants, animals and men. Geomorphology must make way for climatology, the keystone of the geographic arch.

Fourth. The development of plant ecology, made familiar by Schimper, Warming, Cowles, Clements and others, has opened a new world in what Schimper frankly calls plant geography. Ecology, as defined by Haeckel, is "the science treating of the reciprocal relations of organisms and the external world," and biogeography, the ontography of Davis, is nothing but universal ecology. Some field and class work now done in geomorphology might be profitably replaced by work in plant ecology, as being more distinctly geographical and as furnishing a better introduction to the study of human relations.

The vegetative covering of the earth, a true phytosphere with some holes in it, forms a concrete expression of the structure and relief of the earth crust, of climate and of the efficiency of solar energy, "a visible synthesis of the climatic and edaphic elements." A single map of plant regions tells more about actual climate than a series of temperature and rainfall maps. Vegetation forms the basis on which animal and human life subsists and has more to do with economic geography than any other natural factor. With an adequate preparation in climatology and plant geography, the way is clear as never before for the development of the culminating phase of our science, human geography.

Fifth. The demand of a commercial and industrial age and people for something which will help more directly in the business of making a living or a fortune may be rationally met. The rubble heap of commercial geography, hitherto a collection of facts and figures which largely cease to be true before they can be printed, and fortunately must be forgotten as soon as learned, may be transformed into a science of economic geography, a study of natural resources and the ways in which men have utilized them to get various kinds of a living, and may utilize them to get a better living. This is the plane along which geography touches the masses of men most closely, and can do most to promote better citizenship and a higher civilization. A geography which is generalized ecology must be in the broadest sense economic.

Sixth. There is still a higher phase of geography in which much can be accomplished, the scientific study of environments in the relations they bear to all the activities of human life, economic, social, political, esthetic and religious. This means a notable development of regional geography and, as I have shown elsewhere,* on the basis of natural rather than political divisions. It means also the use of a greatly extended variety of charts and maps. The dream of Ritter, Guyot, Buckle and Ratzel may be realized, and it may be possible to show the relations of human life to natural environments in a manner so clear and convincing that no economist, sociologist, historian or statesman will dare to ignore the geographic foundation of his science. The result may be a higher and broader teleology which shall show that our highest ideals are realizable on this planet and how the earth may become the home of men who shall be as far beyond us as we are beyond the cave dwellers.

To awake from our dream of the geography of the future and come back to the practical affairs of the present. The first steps toward a newer and better geography in the schools have already been taken. Officially inaugurated by Davis in his St. Louis address, the movement has gone on at such a rate as to show that it is not a temporary and transient phenomenon. It has been materially helped by the reports of the committees of the National Educational Association and the Association of American Geographers.† The two reports agree in recommending the omission of extraneous matter, the abbreviation of many topics hitherto found in current texts, in the expansion of many others more closely related to human life, and the introduction of a considerable amount of the economic and regional geography, in one case of the United States and in the other of the principal countries of the world. They mark a decided step forward toward humanization. Among other notable articles and discussions, all having the same general purport, I would cite as especially valuable The Round Table Conference on Geography for Secondary Schools, led by Dodge at the 1908 meeting of the Association of American Geographers; the Conference on the Organic Side of Geography, Its Nature and Limits, led by Brigham at the 1909 meeting of the same association; Physical Geography in the High School, by E. E. Ramsey, School Science and Mathematics, Vol. 11, p. 838, and Vol. 12, pp. 45 and 114; and High School Geography, What of Its Future? by R. H. Whitbeck, Educational Bi-Monthly, June, 1911.

The forerunner among books was the little volume of Prof. and Mrs. Herbertson, *Man and His Work,* published in 1902, which has had a rather wide distribution in this country and should be on the desk of every

*Journal of Geography, Vol. 11, p. 73.

†Journal of Geography, Vol. 8, pp. 1 and 159.

teacher. The pioneers of the newer geography have been British rather than American. Mr. Mackinder, by his brilliant lectures at the Universities of Oxford and London, by his occasional articles, and by his masterly book, *Britain and the British Seas,* has been an inspiration to thousands toward the attainment of that point of view which he calls geographic. Now as a member of Parliament, high in the councils of the nation, he is a potent influence in the administration of the greatest empire on earth. Dr. Herbertson by his teaching at Oxford, by the organization and direction of the Geographic Association, by his numerous books and perhaps more by his series of wall maps, is leavening the dull and bureau-ridden schools of Great Britain with new geographic life and making unique contributions to sound views and methods throughout the English-speaking world. Do you all know that, thanks to Dr. Herbertson, you can now buy a set of Oxford wall maps for the world and for each continent, showing physical features, structure and soils, thermal regions, pressure and winds, rainfall, vegetation, natural and economic regions, and political divisions? Miss Semple has crowned the labors of a learned life by her monumental work on *The Influences of Geographic Environment.* From Prof. Brunhes of Fribourg comes *La Geographie Humanie,* a volume of 800 lucid and charming pages, which it is to be hoped, somebody will translate into English. These two books are epoch making in that they are the first since the days of Ritter and Ratzel to present human geography in a systematic and masterful way. Among the textbooks belonging to new species are the *Physical and Commercial Geography* of Gregory, Keller and Bishop, or for short the "Yale Geography," the *General and Regional Geography* of Unstead & Taylor, one of the first fruits of the Oxford School, *The Elements of Geography,* by Salisbury, Barrows & Tower, or the "Chicago Geography," and to descend a little nearer to the high school freshman, Dryer's *High School Geography.* Others will probably appear in the near future. The texts of the new types are necessarily tentative adaptations, and no one can say precisely what the representative book of the coming decade will be. I venture to predict that it will be thoroughly biogeographical, economic and human, that the treatment will be largely regional, that the unit regions and divisions will be more natural than political, and that the principal countries of the world will be included in its scope.

The new geography will be richer in both quantity and quality of information and will not be lacking in scientific discipline. It will not be exactly the kind of discipline furnished by laboratory physics, chemistry or botany, but a truly geographical discipline, in which that of natural science, technical science and social science will be effectively blended. Such information and such discipline yield to no other in value for training the men and women of the coming generations, who are to be in a deeper sense than any before them citizens of the world.

THE PORT OF CALCUTTA

By GEORGE L. COLLIE.

Beloit College, Beloit, Wis.

SITUATION.—Calcutta, one of the three great ports of British India, and the second city of the British Empire, is situated on the east bank of the Hugli river, a distributary of the Ganges. The city is about 80 miles from the sea and 40 miles south of the point where the Hugli leaves the Ganges. The importance of Calcutta as a port depends upon its situation, near the sea, on a branch of the great Ganges river system; the latter circumstance giving it access by cheap methods of transportation to the interior of India. Extensive canal and trunk railway systems also connect the port with the interior and aid greatly in the movements of commerce. By reason of its position, Calcutta, like Colombo, is a meeting place between the commerce of the Further East and that of the West.

Importance of the Port. Calcutta was formerly but a second-rate harbor, but in the last few years it has out-distanced its former rival, Bombay. Nearly 45 per cent of the whole trade of British India now passes through this one center, the volume of trade nearly equalling that of Bombay and Rangoon combined. Calcutta is the great jute port of the world, and it is also extremely important as a shipping point for rice, grain, cotton, etc.

The Hugli and its Characteristics. Like other distributaries of large rivers, the Hugli is a broad, swift, overloaded stream; almost unnavigable when not subjected to careful engineering supervision. Above Calcutta there is little or no such oversight; the river is a law unto itself, shifting and silting its channels at will. No sea-going vessels proceed above Calcutta, only lighters and various river craft. Below Calcutta, fluvial engineers vigorously prosecute their work, with the result that the river is navigable for the largest ocean steamers that visit India. Great dredges are employed constantly to keep the channel open and at the required depth. Engineers' assistants are busy at work in small boats making soundings over the bars and moving the buoys to indicate the shifts taking place in the channel; for constant change is going on, in spite of all efforts to the contrary. A river pilot gave the writer an illustration of the rapid alterations that may take place at certain stages of the water; he stated that he was bringing a large steamer up the river and, as they were crossing one of the bars, the boat ran aground in two feet of mud. According to a report issued but twelve hours before, the steamer should have cleared this bar by three feet; that is, there had been a change of depth of five feet in a few hours in the channel across this particular bar. There are five or six trou-

blesome bars between the Sunderbunds at the Hugli mouths and the Howrah bridge in Calcutta. Daily pilot reports are issued on the state of the water, on the depth of water over the bars and on the changes in dredging plans, the alterations in the channel, and in the position of buoys. Frequently it is necessary to issue bulletins every twelve hours, so rapid are the changes that take place, especially in the matter of silting. The necessity of constant dredging, under such circumstances is self-evident.

A trip down the Hugli presents some marked contrasts to trips which one might take on northern rivers. There are, on either hand, great stretches of luxuriant, tropical forests with quaint villages embowered within them; strange-looking sampans scurry about, manned by dark-skinned natives; another type of architecture prevails, stately temples and gold-covered pagodas, with their tinkling bells and gaudy colors replace the more sombre and substantial buildings of the north-land.

Features of the Port. At Calcutta the river is three thousand feet or more in width and its banks are low and frequently marshy. Very often the banks are left in their natural state, except that they are tramped down by the feet of countless natives who swarm back and forth between city and river. In many instances, on the other hand, the banks are paved or faced with stone steps and terraces, from which wood or stone wharves or quays are frequently built out into the stream. The native term "Ghat" is used indifferently for the natural or the artificial banks and for all landing stages and piers as well. There are few good docks in Calcutta; these are chiefly located at Kidderpur, a suburb to the south. As a rule the warehouses, waiting-rooms, and other accommodations are inferior to those of Europe and America. An illustration of conditions may be inferred from the writer's own experience, after engaging passage to Rangoon. Two days before the steamer was to sail a card was received, which read as follows:

The British Indian Steam Navigation Company
Announces that the Steamer Bharata
will leave the Chandpal Ghat for Rangoon
October second, 1910,
at six A. M.

Promptly at the hour named the passengers gathered under a shed with open sides, which formed the sole waiting room at this particular ghat. A heavy mist rolled in from the river and a hard rain was falling. The wind blew the rain in upon the huddled group; it was a full hour after the advertised time before the steamer left its anchorage in the river and, swinging about, came up to its berth at the ghat and the drenched passengers got aboard. Such conditions would not be tolerated in the West, but they are characteristic of the Orient.

Most of the shipping lies out in the river, where there are numerous

anchor-buoys for purposes of attachment; these are arranged on each side of the river, near the ghats, leaving a wide channel in the center for traffic. The river is crowded with steamers, sailing vessels, lighters, tugs, sampans, and ferry boats; as the shipping is generally massed in close quarters, it makes a great impression on the beholder, as he comes up the river by boat.

Since most of the shipping anchors in the stream and does not come up to the docks, it follows that goods must be transferred to and from shore by means of lighters, an awkward and cumbersome method of handling freight. A river boat or lighter, perhaps from far up the Ganges, comes down laden with rice; it runs up alongside the assigned steamer, makes fast and then immediately begins to discharge its cargo. Unloading of perishable freight, such as rice, is frequently interrupted by showers or by a steady rain. Often vessels are delayed for several days by such occurrences, whereas, if the steamer were at a dock where loading could go on from a covered shed or warehouse, there would be no delay.

The lighters have a rather uniform canoe shape, with a tarpaulin or canvas awning spread over one end, under which the crew lives; they are propelled by sail or rowed by half naked coolies, who make slow progress against the stream. The lighters used for unloading vessels come up to those ghats, which are paved or have tidal landing stages, ox-carts back down to the water's edge, receive their quota of freight and then laboriously move up the slopes to the sheds above. Behind the shed-like warehouses there are lines of railway, which communicate with the chief trunk lines, and these readily take or deliver the freight offered to them. Between steamer and railway the freight is handled by the antiquated and time-consuming methods, described above, yet there is little use of introducing new ways, when the coolie refuses to adopt them. "The East is East and the West is West," in respect to harbor facilities as well as in many other particulars.

In Calcutta, and for some distance down, the banks of the river are lined with jute and cotton mills, and brick or tile yards, each factory with its own pier and generally its own loading appliances. On leaving Calcutta the steamer quickly pushes its way down the river, guided by the channel buoys, if by day, or by many fixed or flash lights, if by night. The river gradually widens, its diked banks at last fading from view; but even after the low banks have disappeared, islands and shoals are seen, marked by buoys or light ships. Even out beyond the mouth of the river, the steamer is surrounded not by the ordinary green or blue waters of the sea but by the yellow, turbid flood of the mighty Ganges, which for miles out, still continues to discolor the ocean itself.

HARNESSING THE FATHER OF WATERS

HARLEY P. CHANDLER,

The Principia, St. Louis, Mo.

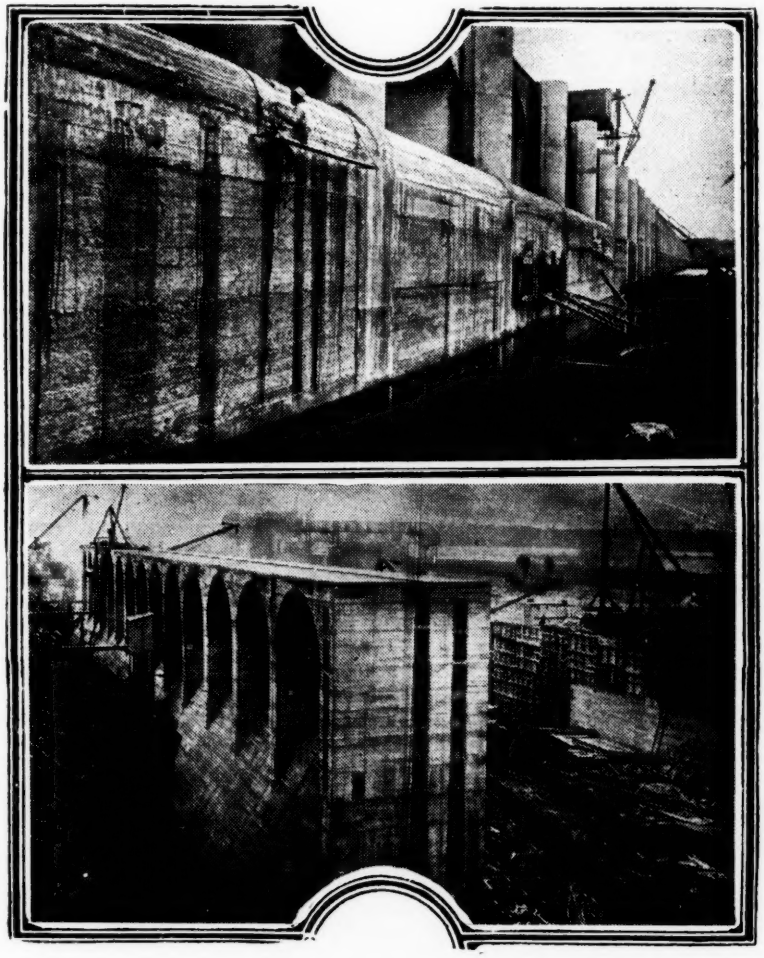
IN the last decade there has been a remarkable growth in the demand for conservation of our natural resources. Whatever may be one's views as to the extent to which the government should concern itself with conservation, and whatever methods of proceedure one may favor or oppose, all thinking people are agreed that the future prosperity of our country will be largely dependent upon our use of what Nature has given us.

Not the least of these gifts, though perhaps the least appreciated, is water power. President Benjamin Ide Wheeler, of the University of California, states in a recent magazine article that in the Sierra Nevadas alone there is enough water power wasted to run all of the engines in the world. What then of the innumerable swift streams which flow down the Rocky and Appalachian mountains? What fabulous quantities of energy do they waste in useless or even harmful erosion—energy which might be turned to useful account? Every year 21,300,000,000,000 cubic feet of this water is discharged through the Mississippi into the Gulf of Mexico, having scarcely so much as turned one turbine in the service of man.

But this is an age of big things and even the Father of Waters is being harnessed and will be made to work. The longest one-piece dam in the world has been practically completed, and by the spring of 1913 the waters of the Mississippi will be running through turbines and generating electricity.

The Des Moines Rapids, in the Mississippi River at Keokuk, Iowa, have long been recognized as affording a favorable place for the development of water power. But to build a dam across a swift stream a mile wide, to construct buildings and machinery for the utilization of the power, and locks to permit the passage of boats; to build ice fenders to protect the works and sea walls to protect the shore, to determine the boundaries of the lake to be formed by the building of the dam, and to pay for the land which would be flooded—all this makes a problem in engineering and finance which would stagger the man who thinks small. From the time when Robert E. Lee, then a lieutenant in the United States army, first reported to the War Department that it would be feasible to develop water power at this point, until a few years ago, the matter had received intermittent attention. Finally, in 1905, Congress authorized the Mississippi River Power Company to undertake the work, under certain very exacting conditions. These conditions were accepted, the work was begun, and by May, 1913, the task is to be completed.

The Power Dam and Lock at Keokuk.



The picture shows how the great dam is built like a bridge with 119 arched spans in each of which is a spillway over which the water will run. On top of each spillway, sliding in the slots seen in the piers, will be a steel gate eleven feet high. The spillways are thirty-two feet high. The water surface will be about at the bottom of the semi-circle in the border. The dam is nine-tenths of a mile long.

The bottom picture shows part of one wall of the collossal lock, with the same width and a higher lift than any lock at Panama. This will is between the lock and the dry dock adjoining. The dry dock on the arched side of the wall will be one of the largest in the world. The lock, dry dock, and other things with a value of many millions of dollars, become the property of the United States without a cent of cost, immediately upon their completion.

The first step was to construct a great cofferdam, 76 by 1000 feet. The water was pumped out of the enclosure within the cofferdam, and the first portion of the permanent concrete dam was laid there, sunk five feet into the solid rock of the river bottom for the sake of security. While the concrete work was in progress here, another section of the cofferdam was laid ahead, so that the work could proceed steadily. In this way the dam progressed 4649 feet across the river from the Illinois side to the Iowa side. There it met the great cofferdam which still encloses the unfinished power house, lock and dry dock. The dam is now practically completed and the river is given temporary permission to flow through the middle portion. When the construction work on the Iowa side is completed, the last span of the dam will be closed, the cofferdam surrounding the buildings will be removed, and the water will be put to work.

The great turbines are a special design of the Francis type, each 16 feet 6 inches in diameter. With the normal water head of 32 feet, each turbine will have a capacity of 10,000 horse power. The water reaches the turbine through four intakes, which converge into a chamber 39 feet in diameter in such a way that the water strikes every point on the circumference of the turbine with equal velocity. Fifteen of these turbines will be installed at first and fifteen more later. The power house which encloses them will be 1718 feet long with its length parallel to the shore.

Between the power house and the Iowa shore are the lock and the dry dock. The lock is 110 by 400 feet inside and will pass vessels drawing eight feet of water. The dry dock is to be 150 by 463 feet, which is only one per cent smaller than the one in the Brooklyn Navy Yard. The lock and the dry dock, together with the machinery to run them, are being constructed by the power company and will be deeded to the United States government in return for the privilege of developing the water power.

In addition to those already mentioned, the power company is building two other concrete structures. The first of these is a sea wall 1110 feet long and 45 to 73 feet high, to protect the railroad tracks along the shore. The second is a great ice fender 2325 feet long. This is built about the power house and locks to prevent ice-jams from damaging them. It consists of a concrete pier extending five feet above the water but with openings beneath the surface to permit the free flow of water under the ice. A floating boom of timbers will close the entrance to the enclosure between the ice fender and the power house and locks during the winter, but it will be removed during the season of navigation.

The dam, power house, lock, dry dock, sea wall, and ice fender together constitute an enormous monolith of concrete, 2½ miles in linear measurement and 18,000,000 cubic feet in volume. Their construction involved the building of 15 miles of railroad track and the purchase of machinery worth $1,000,000. About 2500 men are employed, all under the super-

vision of the chief engineer, Mr. Hugh L. Cooper.

The completed plant will be able to develop 300,000 horse power of electricity, though but 200,000 horse power are to be offered for sale at first. Electric companies in St. Louis, 137 miles away, have contracted for 60,000 horse power for a term of 99 years. The remainder of the output will be used chiefly at Keokuk, Fort Madison, and Burlington, Iowa; Hannibal, Missouri; Hamilton and Quincy, Illinois, and neighboring cities. Probabilities point to the development of a great manufacturing center in this part of the Mississippi Valley, owing to the rare combination of cheap electric power, good facilities for water transportation, and good railroad connections. It is estimated that the output of power for manufacturing from this plant will be the means of supporting 1,000,000 people, when it is all put to use. Incidentally, it will conserve nearly 1,000,000 tons of coal every year.

The benefits of this great work are not restricted to those which arise from the use of the water power. It will be a great help to navigation. At present the Des Moines Rapids are evaded by means of a long, narrow canal with three small locks. When the Mississippi River Power Company's plant is completed this canal will be submerged under more than thirty feet of water and boats will have to stop only long enough on their trips up and down the river to pass through the one lock, which will elevate or lower them forty feet. It is expected that the passage through the lock will occupy a boat about fifteen minutes. The closing of the great dam will back the water for 65 miles, forming a great lake. Under the conditions fixed by the government, the power company must provide a channel not less than eight feet deep through this slack water, whereas under present conditions there is often less than a three-foot channel.

While this is the first great power plant to be built on the Mississippi or its larger tributaries, it is to be hoped that it will not be the last. On the main river there is no other place so favorable for the development of power as at the Des Moines Rapids, because in order to obtain sufficient fall it would in most cases be necessary to back the water up over valuable agricultural land. But in the upper courses of the Mississippi and its confluents there are countless places where power can be developed without injury to the land and with inestimable benefit to the country. It is to be hoped that the venture at Keokuk will be so successful that capital will be encouraged to take further steps in the same direction.*

*An illustrated article on this subject also appeared in the *World's Work* for January.

THE STUDY OF MINERALS AND ROCKS IN HIGH SCHOOL PHYSICAL GEOGRAPHY

By WILLIAM P. HOLT,

Commercial and Manual Training High School, Newark, N. J.

IT is an interesting fact that two of the best-known university teachers of physiography in the United States have almost, or entirely, omitted the consideration of minerals and rocks from the text-books which they have written for secondary school use. I wish to raise the question—Is such an omission desirable?

Both of these authors, who have written their text-books from the college viewpoint looking down (i. e. simplified), rather than from the high school standpoint looking out, have given considerable attention to the composition of the atmosphere and hydrosphere, but have done little in their text-books to turn the pupils' attention to the composition of the lithosphere.

Some simple experiments to bring clearly before the pupil something of the nature and properties of the gases composing the atmosphere have been found worth while with first year students. Why not also attempt to teach our pupils something definite regarding the principal rocks and minerals composing the lithosphere? Yet there are many schools where the pupils learn almost nothing of the latter by work with actual specimens.

By collecting some of the more important rocks and minerals of the region where the pupil lives, the idea is early brought home that these are a part of the "real thing" about which he is studying. Much of the elementary study of the lithosphere may be so "perfectly general as to be perfectly meaningless" to the young pupil; here is, at least, one point of contact which is concrete.

Moreover, from seeing nothing but soil or vegetation on the surface many of the pupils overlook the fact that there is a bed-rock below; in fact, many of them graduate from high school without knowing the nature of the bed-rock in the region where they have studied. If teachers of physiography doubt this, let them question their classes carefully on this point—even in some schools beyond the high school.

Not only is a brief study of minerals and rocks a *logical* part of the earth science course—call it physical geography, physiography, or what not—but I have found that a reasonable amount of time given to such study early in the course is an unfailing means of *deepening an interest* in the subject, especially where each pupil is required to make a collection of his own and become thoroughly familiar with it.

The collecting instinct is generally still active in the first or second

year of the high school and needs little stimulating. Where I have required a collection of thirty-five rocks, minerals, and building stones as a minimum, I have found some pupils in every class who have gotten together seventy-five to one hundred, or even more, different specimens. One of the requirements in such a collection was that each pupil should pass an individual oral examination upon *his* specimens and show that he knew something of their properties and distinguishing characteristics, as well as their names. The pupils could get their specimens from the field or stone yards, from the garret at home, by trading with one another—get them in a variety of ways—the principal thing being to get them and to *know* them.

Some of the collections thus started have been added to long after the required work of the course was over, especially where the pupils at the start were given encouragement and suggestions in labelling and arranging their specimens. Personally, I have always felt well paid in securing additional material from the region, material which would be broken up and placed at the disposal of the class in the form of "special offerings." Of course, a reference collection is necessary to assist the pupils in identifying their specimens; but this is not a matter of great expense as it can be secured largely from the region, and should be a part of the working equipment of every school.

In the glaciated portion of the United States pupils might bring in some specimens of fine grained boulders that could not be determined to a certainty, but those of coarser structure in most cases could be recognized; in any case the lesson could be emphasized that the specimens represented *erratic* boulders *entirely different* from the underlying bed-rock, and therefore that their presence in the region was a matter of interest to be accounted for.

Some regions are naturally richer than others in materials for such collections, and there may be places where it might be difficult to secure, in the ways already suggested, 35 different specimens for the individual collections. However, typical glaciated fragments, pebbles, angular talus fragments, wind cut stones, specimens showing disintegration and weathering, can be added; even different kinds of soils, for the latter certainly are of interest in any study of earth science, and can be secured in any region.

Regardless of the wealth or poverty of any region in natural specimens, good representative specimens can be *purchased* cheaply enough for the individual collections. As a part of the working equipment of our school, we have individual student collections of 60 to 65 minerals and rocks (mixed) which were purchased for 45 cents a set. These fragments are of moderate size, a part of them over an inch in length, and were purchased from the Howell Microcosm, Washington, D. C. (Mr. George Robertson, Manager), having been selected from the Student Collection of 40 minerals and 40 rocks each, and cut somewhat larger than the fragments generally

sold in these collections. Other dealers* in rocks and minerals can doubtless furnish similar collections.

Aside from the value of the study of such material in giving the pupil a more definite understanding of the composition of the solid part of our earth, incidentally it is a most excellent training in keen, discriminating observation; and this, in itself, is of no small value as a life preparation.

While the work with the purchased collections possesses much value, nothing can take the place of the specimens secured by the pupils themselves in their own region; and in *getting out* to get this material either individually, or on class trips, they are bound to see much of physiographic interest in the field. The questions often raised by pupils after such trips are often gratifying, for they indicate that the field trip has caused them to *observe* and *think*. If the making of such collections served no other purpose than getting pupils out into the field more I believe it would have an unquestionable value.

While this is only one of several lines of valuable laboratory and field work that should be included in every well developed course in high school earth science, and should not receive undue prominence, I believe it is entitled to more consideration than it is receiving at present in many secondary schools. Moreover, I do not know of any secondary school where such work has been carefully tried and has failed to yield results if recognized and unquestioned value.

NEW ENGLAND FARMING; ITS PRESENT AND FUTURE

By WALTER LEFFERTS,

Philadelphia, Pa.

New England represents two widely different sections, the northern and the southern. The first, including in a general way Maine, New Hampshire and Vermont, is a region of scanty population, where agriculture, although unimportant in a national sense, still employs a considerable proportion of the people . The second section, embracing Rhode Island, Connecticut, Massachusetts, and a small part of New Hampshire, is more densely populated than any other region of the same size in the United States, and looks to manufacturing as its main support. In both sections, however, cereal raising has suffered a great decline.

Like Old England, New England produces but a part of the grain she

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*Geography Supply Bureau, Ithaca, N. Y.

Ward's Natural History Museum, Rochester, N. Y.

needs. In 1899 she raised to each inhabitant a little over three bushels of cereals all told. Had this been entirely wheat, and had it been used for the food of human beings without applying any to the maintenance of animals, it would have furnished about half of the bread consumed by the people. Ten years later, in a better crop-year, the cereals of New England averaged about two and one-half bushels to a person. In other words, while the population of New England had increased 17 per cent, its cereal yield had decreased nearly 3 per cent, and its acreage of cereals over 7 per cent.

The New England farmer has always been handicapped in cereal raising, by stony soil, rough land, and severe climate. While markets were local and transportation poor throughout the United States, he managed fairly well, however; but as more fertile regions became able to produce and distribute for the benefit of all, he felt an increasing disadvantage. The worst blow to his business came in the opening of the great western grain fields during the 70's. Then old-fashioned farming in New England went faster and faster downhill. Many of the farmers abandoned their fields, a process which is still going on, but at a diminishing rate.

Less New England land is cultivated today than was tilled forty years ago. The scratcher of the ground has been eliminated. The farmer who is not working to the best advantage is fast going. The New England yield per acre of cereals is the highest in the United States, because only the fittest land is used for them. Force of circumstances has brought this about. In the effort to make a living, the New England farmer is using only the best fields of his farm for crops. The average Connecticut farmer, uses less than half of the land which he owns. The New Hampshire farmer uses little over a quarter.

So far as cereals are concerned, New England agriculture has been shaken down nearly to a solid basis. New Englanders have now definitely made up their minds that it is profitless to raise wheat, and that even the hardy rye, buckwheat, and barley are usually unprofitable. In the northern section the climate is too severe for corn as a grain crop, though for canning purposes the sweet corn of southwestern Maine is unequalled. Oats are the only cereal which seems really worth while. They resist sudden climatic changes, serve as a food for man and beast, and find a ready market.

CONDITIONS OF OTHER BRANCHES OF AGRICULTURE.

Even on the fields which he still uses, the New England farmer finds it more convenient to gather hay, or to pasture cattle than to till the ground. The average Vermont farmer, who uses 75 acres of land, can put in a ten acre lot all the oats, barley, corn, buckwheat, beans, and potatoes which he raises. The other 65 acres is given over to grass. The Rhode Island farmer, with his ten acre lot of miscellaneous crops, corn constituting more than

half of the acres, has nearly four times as much land in hay and pasture. Yet, even the grass-land of New England is on the decrease.

The men who had no other idea of farming than that of cereal agriculture have been abandoning the industry. The decrease in land farmed has been directly due to this, and only in small measure to the swallowing up of land by the advance of cities and towns. Despite the increasing abandonment of farms for twenty years before, the decade of 1900-1910 saw over three thousand more lost to agriculture; as manufacturing increases, general agricultre declines. This is not a necessary result, however.

It may be thought that even if most of the cereals are unprofitable crops when sold directly, they could be made the foundation of animal raising. Though New England cannot furnish her own bread, could she not produce more of her own meat supply? The market at home is great. In southern New England live over three-fourths of the population. It has nearly five-sixths of the workers in mills and factories, although it contains less than one-fourth of the area. It is a community of city-dwellers. In 1910, 62 per cent of its people lived in cities of over 25,000 population. One out of every five people works in a manufacturing establishment. These city-dwellers must be fed.

The farmers of New England have been unable or unwilling to completely rise to the opportunity. Fewer cattle are raised than a decade previously. There are less than half as many sheep as in 1900. As population increases, the number of dogs grows also, and dogs and sheep do not generally live in harmony. More pigs and chickens are raised than formerly, however. They can be produced as side lines on a farm and are capable of yielding a good profit. As a partial substitute for meat, milk and its manufactured products are cheaper for the same food value. Dairying has grown in New England along proper lines—that is, by improvement of the members of the herd rather than by increase in number.

The very expansion of population in New England, particularly in its southern section, while it seems to furnish a market for farm produce, is a check on old-fashioned farming. The farmer who lives in a section where there is prosperous manufacturing finds that the value of his land has increased. That is good providing someone wishes to buy and he desires to sell; but so long as he stays on the land it has other results. Even at the old rate of taxation, if his land is assessed at higher value, he must pay more taxes. In a "prospering" community the tax-rate tends to increase. Schools, roads, bridges, public buildings, salaries of officials and many extra costs, make the farmer pay more for living in the midst of modern civilization. And how is he to pay? He may ask more for his old-fashioned products,—his grain, his hay, his cattle—but that exposes him to the competition of other parts of the country. Another method is to work his higher-priced land harder so that it may earn greater interest on its value.

Each acre must produce more dollars than it did before.

Therefore, the intelligent farmers of New England have been looking about for ways of turning their ground to better account. Maine has found a money crop in potatoes. Aroostook County in the far north supplies to the growers of the Middle Atlantic States seed which gives an earlier crop than their home-grown potato seed. Through this natural pre-eminence, a union of favorable climate and soil, that part of Maine has nearly doubled its potato acreage since 1900. In the Connecticut Valley, tobacco, raised largely under canvass, gives such heavy yields that growers in other states are becoming envious. Massachusetts uses some of her low sandy lands on or near the Cape for producing cranberries. Almost two-thirds of the money received for berries in the state in 1909 came from cranberries. Peaches have proven valuable in Connecticut.

PROBABLE FUTURE.

At present only 18¼ per cent of the land area of New England is in any way used for farming or pasturage. It is scarcely probable that much of the abandoned land will be brought back to agricultural uses in the near future. Most of it could profitably be forested, especially in white pine. This would also preserve the water-supply, which in spite of the use of steam is still necessary to the manufacturing of the region. One-fourth of the power used by New England factories comes from falling water.

In no state except Maine is it likely that much new land will be utilized for farming, and even in Maine the increase will not be large, for climate and soil offer hindrances to most kinds of agriculture. Will the present area of improved land in New England, which represents the best land left, be used in the future? What is the prospect for agriculture in the region? Cereal raising is likely to become even less important as time passes, and in the southern region, at least, general agriculture will be of constantly decreasing importance in the occupations of the people. Yet, through specialized farming there will be opportunity for a considerable population to make a good living from the soil and to supply much more of the local demand for food than is supplied at present. The old-fashioned farm system has had its day in New England. Dairying will necessarily increase in importance as population grows, and New England has room for this increase. In many sections dairying now forms the basis of the farm-system. Vermont and New Hampshire could raise many cattle. Sheep should thrive if the ravages of dogs can be prevented. Market-gardening near towns is already a great industry, and with the use of glass should increase tremendously. No northern fruit can take the place of the apple, and with modern methods of spraying, pruning, picking, and grading, the New England apple should hold the market against the western product.

With her hill-tops forested, apple-orchards and pasture-lands on the

lower slopes, the valley-lands used for oats, ensilage-corn and vegetables, and with various special crops in the regions to which they are particularly adapted, New England might well reconcile herself to the importing of her wheat and most of her corn from the West, but should resolve to produce much of her own meat. In the change which has come over eastern farming, the New England agriculturist has not yet adapted himself to new conditions. There is no apparent reason why he should not be able to meet them.

MINERAL INDUSTRIES OF THE UNITED STATES

By R. H. WHITBECK

IN the production of minerals the United States is far ahead of any other country. Of course no other country of comparable area has its mineral resources so well developed. Canada, Russia, China and Brazil are all rich in minerals, but the extent of these resources is, to a large degree, unknown. The great producers of minerals in Europe are Germany and the United Kingdom, and the high industrial development of these countries is immediately related to their wealth of coal and iron. No. European country even closely approaches the United States in mineral production, when variety and quantity are both considered. England is particularly rich in coal, imports a third of the iron ore which it uses, and produces practically no copper, gold, silver, zinc, or lead. Germany has a larger variety of minerals, so has Spain, yet neither is in the same class with the United States. Austria-Hungary is the fourth largest coal producer in the world, yet three states of the United States are larger producers—Pennsylvania, West Virginia, and Illinois. Two counties in Pennsylvania mined nearly as much as Austria-Hungary last year.

The value of the minerals annually extracted in this country reaches the enormous sum of two thousand million dollars. (Yet this is less than a quarter of the annual value of our agricultural products.)

Coal leads, then follow in order iron, copper and gold. Practically all of the anthracite or hard coal comes from a small area in eastern Pennsylvania. The best soft coal comes from western Pennsylvania and other states included in the Allegheny plateau. Coal of varying qualities is mined in twenty-eight different states. This wide distribution among the states is a matter of no small importance, for it places fuel within easy reach of nearly all parts of the country. The Pacific coast states do not contain large coal deposits. They import some coal from Australia and Canada. When the Alaskan coal fields are developed, the Pacific coast will be able to take most of the output. The state of Washington produces three or four million tons of coal a year, and Oregon produces a little.

The mineral wealth of Pennsylvania is fabulous. No gold or diamond

mines of ancient or modern times remotely approach in value the coal mines of this state. The average value of all coal at the mines is about $1.25 per ton. At this valuation, the coal annually mined in the United States reaches a total of over $600,000,000, half of which is creditable to Pennsylvania.

The states which in 1911 produced upwards of 10,000,000 tons are as follows:

Pennsylvania—	
Anthracite	90,500,000 tons
Bituminous	145,000,000 tons
West Virginia	60,000,000 tons
Illinois	54,000,000 tons
Ohio	31,000,000 tons
Alabama	15,000,000 tons
Indiana	14,000,000 tons
Kentucky	13,700,000 tons
Colorado	10,000,000 tons

Iron. The United States mines far more iron than any other country. In fact, the state of Minnesota produces more iron than any foreign country. From one iron range in Minnesota, the Mesabi, is yearly taken more iron ore than any European country produces. There are only two really important iron-mining regions in the United States and one of these—the Lake Superior ranges in Minnesota and Michigan—yields ten times as much as the other, that of Alabama. Most of the iron ore from the Lake Superior mines is taken by ore steamers to points on Lake Michigan and Lake Erie, whence it go to the smelters.

Pennsylvania, particularly the Pittsburg district, is the region of greatest smelting activity. More than one-third of the pig iron and one-half of the steel produced in the United States is produced in Pennsylvania. During the past season, iron ore was carried from Lake Superior ports to Lake Erie ports for the very low rate of 40 cents a ton.

Copper. The United States now mines more than half of the world's supply of copper, a metal of great importance in this age of electricity. At present Arizona is the leading producer, followed by Montana and Michigan. These three states yield nearly three-fourths of the nation's output.

Gold is mined in large or small amount in over 20 states and territories, but three-fourths of it is mined in Colorado, California, Nevada and Alaska in the order named (1910). The Transvaal, in South Africa, leads the world in the output of gold, producing fifty per cent more than the United States. Our annual production is about $100,000,000, an enormous sum of money, yet if anthracite coal could be bought for $4.00 a ton, all of the gold annualy mined in the United States would not pay for the coal mined yearly in a single county in Pennsylvania, Luzerne County.

Petroleum. Few people realize with what rapidity California has risen in the scale of oil production.

In 1911 California not only led in quantity of product (over 80,000,000 barrels) but produced almost half as much again as Oklahoma, the state second in rank. The Mid-Continent field omitted, California produced as much oil as the rest of the United States put together; the United States being omitted, California produced more oil than any entire nation; and if Russia and the United States are omitted, California far surpassed the combined production of all the rest of the world, including Mexico, India, Roumania, Galicia, Japan, and South America.

The rank of the states is easily remembered when one recognizes California, Oklahoma, and Illinois as forming a class by themselves, the lowest (Illinois) producing over 30,000,000 barrels and the three furnishing three-fourths of the entire output. The second group includes Louisiana, West Virginia, Texas, Ohio, and Pennsylvania. In the third group, comprising Indiana, Kansas, New York, Kentucky, Colorado, Wyoming, Missouri, Utah, and Michigan, the largest state production is less than a fourth of the lowest in the second group, and combined these states produced less than 2.2 per cent of the total.

Clay Products. The annual value of our clay products ($170,000,000) is much greater than that of the gold which we produce. In this industry, Ohio is the leading state, followed by Pennsylvania and New Jersey.

The Hudson River region is one of the most interesting brickmaking regions of the United States. This region extends along both sides of the Hudson River from New York City to Cohoes and embraces ten counties, nine in New York and one in New Jersey. The region is commercially interesting not only because it contains immense deposits of brick clay but because it is the principal source of a cheap supply of common building brick for New York City and vicinity—the largest market for building material in the New World.

This industry is of more than usual geographical interest as an example of a great industry carried on under almost ideal geographical conditions. The vast deposits of clay which accumulated during the glacial subsidence of the Hudson Valley, lie close alongside the shore of the Hudson River, a deep navigable waterway. This waterway leads directly into the heart of the most densely peopled section of the United States, the New York City district. The brick, in many instances may be loaded from the yards directly upon the scows which carry them almost to the spot where they are to be used. Transportation charges add relatively little to the cost of these brick, a material of very great importance in the vast building operations of New York and neighboring cities. Note, in contrast, that hard coal from Pennsylvania retails for $10.00 a ton in Madison, Wisconsin, its cost having been multiplied five times by profits and transportation charges between the producer and consumer.

THE WONDERFUL GROWTH OF WORLD-COMMERCE

There seems to be no limit to the expansion of the commerce of the world. In 1850 the combined value of the exports and imports of all countries was 4,000 million dollars; in 1910 is was 32,400 million dollars, or eight times as much, and in 1911 it was 34,200 million dollars. Even in what are known as poor years the increase goes steadily on. It often happens that the decrease in one country is offset by the increase in another. It is a rare occurrence when there is a falling off in all countries at the same time. In 1894 there was a falling off in the export trade of nearly all the European nations as the result of the panic of 1893; but at the same time there was an increase in the trade of countries like the United States, Canada, Argentina, Brazil, Australia and Cape Colony. The greatest increase in the foreign trade of the world has occurred during the last fifteen years. Since 1897 the average annual increase has been over 1,000 million dollars. The only year in which there was not an increase was 1908, following the panic of 1907, when the total value of the world's commerce decreased 200 million dollars. The greatest falling off was in the trade of the great manufacturing nations, Great Britain, Germany, France and the United States.

While a part of the increase of the world's trade is due to the higher prices of many of the products, a careful investigation would show that this continued growth in the value of foreign trade is due for the greater part to the expansion in the volume of trade. The leading nations are each year confining themselves more and more to the production of manufactured products. They are therefore becoming more dependent on the less advanced nations for the raw materials needed to carry on their industries, and for a supply of food for those employed in their manufacturing industries. Intercourse between nations, as a result of improved methods of travel by land and water, has created a demand among the less advanced peoples for certain things in the way of clothing and other products which seem to be associated with civilized communities. Millions of people who formerly never wore clothing at all, and greater millions that never wore a shoe, are now buying the materials for clothing and the shoes supplied by nations like Great Britain, the United States and Germany. The improved condition of the working classes in the leading nations, as a result of higher wages, has increased per capita consumption of the various products entering into their daily life. Increased manufacturing output implies an increase of demand for raw materials, and for the food supplies by the millions of workers in mine and factory.

COMPARISON OF THE IMPORT TRADE OF THE WORLD

	1911	1901	Increase	% of Increase
	——Millions of Dollars——			
United Kingdom	2812.0	2210.1	601.9	27.2
Germany	2309.7	1290.2	1019.5	79.2
France	1575.0	843.2	731.8	86.8
United States	1533.0	880.4	652.6	74.1
Netherlands	1339.9	805.4	534.5	66.3
Belgium	800.9	428.6	392.3	91.5
Italy	648.1	331.6	316.5	95.4
Austria-Hungary	647.9	335.4	312.5	93.2
Russia in Europe	526.6	305.6	221.0	72.3
Canada	502.6	196.4	306.2	155.9
India	445.6	264.7	180.9	68.3
Argentina	353.9	109.9	244.0	220.0
Switzerland	347.8	202.6	145.2	71.6
Australia	325.3	206.5	118.8	57.5
China	306.8	190.2	116.6	61.3
Brazil	257.4	96.1	161.3	167.8
Japan	255.8	127.2	128.6	101.1
Straits Settlements	196.3	144.7	51.6	35.6
Spain	191.8	125.7	66.1	52.6
Sweden	180.2	123.1	57.1	46.4
South Africa	177.3	.....	.....	.....
Denmark	167.0	106.3	60.7	57.1
Turkey	147.2	118.1	29.1	24.6
Egypt	136.1	75.1	61.0	81.2
Chile	127.3	50.8	76.5	150.6
Norway	125.0	76.9	48.1	62.4
Cuba	113.0	66.2	46.8	70.7
Algeria	110.2	61.4	48.8	79.5
Dutch East Indies	.....	92.1	.....	.....
Mexico	95.1	66.2	28.9	43.7
New Zealand	95.0	55.2	38.8	70.3

COMPARISON OF THE EXPORT TRADE OF THE WORLD

	1911	1901	Increase	% of Increase
	——Millions of Dollars——			
United Kingdom	2210.7	1362.7	848.0	62.2
United States	2058.4	1438.0	620.0	43.1
Germany	1928.4	1054.6	873.8	82.9

France	1191.2	774.4	416.8	53.8
Netherlands	1098.4	695.7	402.7	57.9
Russia	779.5	392.2	387.3	98.7
India	706.0	393.2	312.8	79.5
Belgium	640.7	352.8	287.9	81.0
Austria-Hungary	488.0	382.7	105.3	27.5
Italy	418.6	265.2	153.4	57.8
Australia	370.9	323.3	138.6	59.6
Brazil	325.2	197.1	128.1	65.0
Argentina	313.2	161.8	151.5	93.6
Canada	279.4	196.0	83.4	42.5
South Africa	278.8	.....	.....	.....
China	245.5	120.2	125.3	104.2
Switzerland	242.6	161.4	81.2	50.3
Japan	222.8	124.2	98.6	79.3
Dutch East Indies	.....	95.1	.....	.....
Straits Settlements	174.4	114.4	60.0	52.5
Spain	173.7	102.6	71.1	69.3
Sweden	173.3	94.7	78.6	83.0
Mexico	147.0	75.3	71.7	93.9
Egypt	142.9	79.8	63.1	79.1
Denmark	142.7	78.2	64.5	82.2
Chile	123.8	62.7	61.1	97.4
Cuba	122.9	64.2	58.7	91.3
Algeria	98.3	50.5	47.8	94.6
New Zealand	92.5	53.7	38.8	72.2
Turkey	80.0	69.7	10.3	14.8

—[From November *Commercial America.*]

NOTES

RIVER WATER USED EIGHT TIMES.

Power can be developed upon many surface streams and applied to the recovery of the water of the streams after it has sunk into the earth in the lower lands of the valleys. An instance of this character according to the United States Geological Survey is to be found along Santa Ana River in southern California. A part of the water of this river is stored in a reservoir in the San Bernardino Mountains and the flow of the stream is thereby regulated. After it escapes from the reservoir it is diverted through a power plant and electric power is generated. Below this power plant it is rediverted and passed through a second power plant. Below this it is all

distributed and used for municipal purposes and irrigation about Redlands and Highlands. The waters that return from the irrigation are recovered in springs and flowing wells and by pumping plants, a portion of the power developed higher up on the stream being used for the pumping. This recovered water is used for irrigation about San Bernardino and Riverside. A part of it reappears in the river above Riverside Narrows, where it is again taken out into a power ditch whose waters are returned to the river above Corona. A few miles below it is picked up by canals and distributed to the orange and deciduous groves about Anaheim and Santa Ana. The portion of it that returns there, by irrigation, to the ground water is once more recovered by the many pumping plants and flowing wells west of Santa Ana.

A single drop of water in its progress from the mountains to the sea, a distance of only 100 miles, may thus be used as many as eight times for power and irrigation.—[From *Water-Supply Paper* 234, United States Geological Survey.]

LAND EROSION STUPENDOUS.

The surface of the United States is being removed at the rate of thirteen ten-thousandths of an inch a year, or 1 inch in 760 years, according to the United States Geological Survey. Though this amount seems trivial when spread over the surface of the country, it becomes stupendous when considered as a total for, over 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter are transported to tidewater every year by the streams of the United States. This total of 783,000,000 tons represents more than 350,000,000 cubic yards of rock substance, or 610,000,000 cubic yards of surface soil. If this erosive action had been concentrated upon the Isthmus of Panama at the time of American occupation, it would have excavated the prism for an 85-foot level canal in about 73 days.

The amounts removed from different drainage basins show interesting comparisons. In respect to dissolved matter, the southern Pacific basin heads the list with 177 tons per square mile per year, the northern Atlantic basin being next with 130 tons. The rate for the Hudson Bay basin, 28 tons, is lowest; that for the Colorado and western Gulf of Mexico basins is somewhat higher. The denundation estimates for the southern Atlantic basin correspond very closely to those for the entire United States. The amounts are generally lowest for streams in the arid and semiarid regions, because large areas there contribute little or nothing to the run-off. The southern Pacific basin is an important exception to this general rule, presumably because of the extensive practice of irrigation in that area. The amounts are highest in regions of high rainfall, though usually the waters in those sections are not so highly mineralized as the waters of streams in arid regions. —[From *Water-Supply Paper* 234, United States Geological Survey.]

UNDERGROUND WATERS A VITAL NECESSITY.

The importance of underground waters to residents in humid sections is

illustrated by the fact that 75 per cent of the population in Michigan are directly dependent for water upon the underground supply. Another investigation of 19 counties in north-central Indiana indicates that of 54 communities in these 19 counties having public supplies, 45 use wells alone. The urban population is therefore largely dependent upon the subsurface supplies, and the rural population depends almost entirely upon them. One-half of the irrigation and the greater part of the city supplies in southern California, amounting to more than 300,000,000 gallons daily, are drawn from the sands and gravels that underlie the valleys, while in central California a smaller but nevertheless important draft is made upon the same source. It is probable that it would be safe to apply percentages but slightly less than that determined in the State of Michigan to the entire United States, and to the state that nearly 75 per cent of our population depends directly upon underground waters.—[From *Water-Supply Paper* 234, United States Geological Survey.]

PRODUCTION OF MINERAL WATER.

In 1911 67,527,822 gallons of mineral waters were sold in the United States, valued at $7,875,373. Of this large amount 63,923,119 gallons, valued at $6,837,888, were of domestic production. The average price of the domestic water at the springs was 10.7 cents a gallon.

The product in 1911 was derived from 732 springs. New York State led in the quantity of water sold, with 10,245,261 gallons, bringing an average price of 9 cents a gallon, or a total value of $939,003; but Wisconsin, with an output of 5,716,162 gallons, produced the greatest value, namely $955,988, or an average of 17 cents a gallon.

The highest average price received in any State was in Indiana—60 cents a gallon—the production being 1,084,428 gallons. The high price was due to the medicinal reputation of the waters. Maine received an average of 34 cents a gallon and produced 1,254,783 gallons.—[From *Mineral Resources of the United States.*]

GROUND WATER.

It sometimes happens that formations permeated by the subterranean waters abound in soluble minerals, which are slowly dissolved and are either washed out in the springs, to be carried off through surface streams, or are swept seaward at depths beneath the surface. Such solvent action of subterranean waters is well known, but in the central plains region the proportion of soluble matter is so large and so related to other factors that its removal becomes a distinctive geologic agency. As the solution of rock matter proceeds the strata are weakened, and from time to time they slump beneath their own weight and that of the superposed deposits in such manner as to warp the strata, and frequently produce depressions of the surface, when the local run-off following storms accu-

mulates within these depressions and gradually fills them with silt eroded from the rims and neighboring uplands. So characteristic is this process that the general surface over thousands of square miles is of a distinctive topographic type—coalescing basins and low divides forming an irregular surface without continuous seaward slopes. The conditions by which this topography was produced have existed for ages—indeed, throughout the greater part of the vast interval since the Cretaceous—and during these ages the progressive slumping in the deep-lying strata, with the subsequent warping of the surface and shifting of local areas of erosion and deposition, have resulted in an immense accumulation of silts and loams forming the soils and subsoils of the region. Nowhere else in the world, so far as known, are there so extensive accumulations of subaerial deposits as in the central plains, and the accumulation is due primarily to that subterranean movement of the waters which to-day render the silt loams more productive than they would be if watered only by the meager local rainfall.

Under the modern view of the suborganic and dynamic character of soils the chief factor of continuous activity is the circulating soil water, which maintains appropriate texture in the soil body, passes thence into the plants carrying materials for growth in solution, and finally returns through transpiration to the condition of aqueous vapor in the atmosphere. Investigations have shown that in productive regions there are two sources for the soil water, (1) rainfall and (2) the store of ground water accumulated from the rainfall of previous years and nongrowing seasons. Throughout the greater part of the United States the rainfall of the growing season does not suffice to produce crops, and cropping succeeds only as the growing plants draw on the accumulated store of moisture, which is generally equivalent in quantity to the rainfall of several years; in fact without this store, farming, especially during the dry seasons, would frequently fail, so that it may be viewed as the agricultural capital of the country. Generally the best indication of the ground-water level is afforded by wells and springs; and a census of representative wells and springs in every county in the United States was undertaken through correspondence. In the country settled for a quarter century or more there has been a decided lowering of the ground-water level, with of course a corresponding increase in danger of crop loss through drought. Thus, in Michigan the mean water level in 794 wells lowered 2.2 feet during an average period of 18 years; in Minnesota the average lowering of water in 920 wells was 3.45 feet during 14 years; in Iowa the lowering in 1,160 wells averaged 3.6 feet in 21 years. The mean rate of lowering of the ground-water level indicated by the wells in the three States is 0.18 per year, or 4.5 feet during a quarter century.—[From *Bulletin United States Department of Agriculture.*]

THE FORESTS OF NORTH CAROLINA

Seventy-six per cent of western North Carolina is still under forest cover and of the total area of the state something like sixty-eight per cent is still heavily wooded. This high percentage is largely due to the heavy forest growth in the swamp lands of the east as well as in the mountains of the west, for in middle North Carolina much less than half of the land area retains its forests.

The seventy-six per cent of the sixteen western counties is absolute forest land, that is, land that is more valuable for forest growth than for anything else. This forest should remain and serve for the production of timber, the prevention of erosion, and the regulation of water-supply. In middle and western North Carolina, as in deforested regions of similar topography elsewhere, the fields are washed and gullied, the soil on the steep slopes has been removed, and the cleared land has served the farmer's purpose for very few years.

The effect on stream flow of forested and deforested areas is well illustrated near Biltmore. The Davidson River has its upper drainage basin in the Pisgah Forest; the Tuckaseegee River in a deforested land that has been logged, burned over, pastured and farmed. The two areas drained are geologically of the same age and structure; their headwaters are found within the same range of mountains; the rainfall of the two areas is the same; the steepness of the slope is about the same on the two watersheds. The Tuckaseegee, though the larger river, shows greater fluctuations in discharge than the Davidson. The Davidson is practically free from sediment; the Tuckaseegee bears gravel and sand which it often spreads out over fertile lands.

Variations in rainfall and altitude have been important in determining the character of the forests in different localities but the underlying rocks have had a marked influence. A part of the coastal plain deposits has long been known as the pine-belt and the other rocks, as the upland region of oaks. A more detailed study shows a different class of trees for each well-marked geological formation crossed in going from the coastal plain to the high mountains in the western part of the state.—[From paper by Collier Cobb, in *The N. C. Booklet.*]

EDITORIAL

COMMERCIAL GEOGRAPHY

The name "commercial geography" came into use as a translation of "Handelsgeographie" chiefly through the influence of Chisholm. The books which gave currency to the term Handelsgeographic were of a strictly practical, utilitarian, encyclopedic type; and this model has been followed in the

main by Chisholm and his entire school. This choice of a model was unfortunate, as there were even at that time other books of a far more rational and scientific sort; and the choice of a name was perhaps still more unfortunate. "Commercial Geography" emphasizes the movement or exchange rather than the production of commodities, and therefore tends to focus attention on the statistics of imports and exports, rather than on fundamental causes and conditions. A book of this type may possibly serve some useful purpose in a counting house, during the brief interval of time before its statistics become out of date; but it clearly has no place in any school, not even a trade school. There is nothing educational about it, and still less is it of practical value; for all the statistics will inevitably be as absolete as the laws of the Medes and Persians long before any pupil can possibly use them.

It seems evident, therefore, either that a new content will have to be poured into the old term, or else that a new term, such as economic geography, will have to be adopted. In view of the advantage attaching to the use of an established name, commercial geography has thus far found general acceptance, although with reluctance and misgivings on the part of many who doubt the success of this attempt to put new wine into a very old bottle.

Commercial (or economic) geography, as I conceive it, is the bridge by which one passes from the study of the earth to the study of man. In other words, it is at once an earth science and a human science.

As an earth science commercial geography of course rests on general geography and geology, which in turn are founded on the laws of physics and chemistry. This relation to the earth sciences is so close and obvious that it need not be further emphasized here.

It is, however, impossible to go far in commercial geography without making extensive use of the biological sciences. Man is dependent almost entirely upon organic materials for food and clothing, and largely for the satisfaction of his other wants. Moreover, man is himself subject to the laws of biology in the same way as all other forms of life. Human races are as much biological facts as are breeds of cattle or strains of wheat; and so also, in some measure, are nations. Here likewise belongs the geography of disease. The decay and disappearance of civilization in many parts of the ancient Mediterranean world seems to have been in part associated with the spread of the malaria-bearing mosquito into regions where in earlier times malaria had been unknown. Even at the present time, the main obstacle to the full utilization of the rich natural resources of the tropical zone for the satisfaction of human wants is the presence in many districts of micro-organisms which restrict population to a few savages of a low grade. Out of this condition arises the problem of colonization, which is thus at bottom a biological problem—turning on the direct effect of heat and moisture and micro-organisms on the physical constitution of people of the northern races,

and the indirect effect of these conditions, reinforced by contact with inferior races, on the energy, habits, character and death-rate of the colonists.

The natural sciences consequently furnish the point of departure and much of the basic material for commercial geography; but if the earth furnishes the point of departure, man forms the end and purpose of the science. General geography is usually defined as the study of the earth as the home of man; which means that the earth rather than man is the subject of study. Again, anthropo-geography regards man largely as so much passive and plastic material to be worked upon and fashioned by physical environment. Nature is thus still the subject of study even in anthropo-geography, though the record of her doings is read in the mode of life and the institutons of men. In contrast with general geography and anthropo-geography, whose basic idea is the study of the earth as the home of man, commercial geography may be defined as the study of man in delation to the earth. Beginning with nature, the emphasis in commercial geography shifts rapidly to human affairs. In other words, the true subject of the study is not the earth, but man.

The relation of man to the earth necessarily involves the question of adaptation to environment. In the case of man this process is in part physical. This phase of the subject receives attention in anthropology. In the main, however, the reactions of man to his environment are psychic rather than organic. The polar bear, in order to survive, has to grow a non-conductive covering. The man kills the bear, wraps himself in its fur, and builds himself a hut of ice; or, having acquired greater technical knowledge, he constructs a modern home, with storm doors and windows and a steam heating plant. In either case, he interposes between himself and the physical environment a sort of artificial environment which, in so far, obviates the necessity of physical adaptation.

The psychic activities of man are of many kinds, and nearly all of them stand in some relation to his environment. Taine has traced the physical characteristics of England in English literature; and the same connection with environment has been shown for the Mohammedan religion and for Greek art. However, man must have the wherewithal to feed and clothe himself before he can apply his mind to art, or literature, or even to religion; consequently the fundamental psychic reaction to environment is economic. It is by means of economic activity that man is able to create the artificial environment which alone saves him from the alternative of physical adaption, or elimination as a creature unfit to survive. In a broad sense, therefore, economics may be defined as the study of the psychic adaptation of man to his environment.

Psychic adaptation takes many forms; but none more striking than the localization of industries in countries or districts which are by reason of

climate, resources, or the acquired skill of their inhabitants, the best fitted to carry them on. Such geographic division of labor is perhaps the most powerful factor in modern times in strengthening the rampart which man builds to protect himself from an unfriendly environment. The miner in the remotest mountains, the explorer at the pole, is able to survive in an environment which would speedily destroy him if he confronted it naked and barehanded, because in his pack or on his sled are found the results of technical knowledge joined to the resources of many lands. This process of geographic division of labor, which forms the characteristic feature of modern civilization, is the subject matter of commercial geography. In a special sense, therefore, commercial geography is the study of psychic or economic adaptation to environment, both physical and social.

It follows that while commercial geography is founded upon the physical and the earth sciences, and makes extensive use of the results of the biological sciences, it is in respect to purpose essentially a human or social science. In view of the fundamental importance and far-reaching influence of economic adaptation on all phases of human life, it may not unreasonably be held to constitute the foundation of all the social sciences. In this event, the study of commercial geography, when properly taught, would appear to be the logical introduction not only to economics but to the whole group of sciences dealing with human society.

"When properly taught" is indeed an important qualification, precisely as in the case of history, and for the same reason: namely, the comparative ease with which the subject may be taught as a mass of disconnected facts to be memorized. Such teaching is, however, altogether unnecessary and inexcusable in both subjects. Owing to lack of space, the question of methods in commercial geography cannot be discussed here: and there is less occasion for it because a recent article in the *Journal of Geography* (October, 1912) has clearly indicated the dangers and some of the remedies. I have also discussed the same problem elsewhere. It may, however, be proper to point out that poor teaching is an argument, not so much against the subject as in favor of more and better training of teachers; and that while there is undoubtedly some poor teaching of commercial geography, there is also much that is excellent, yielding results in sound training and accurate thinking not inferior to the best in the older subjects.

EDWARD VAN DYKE ROBINSON.

University of Minnesota, Minneapolis, Minn.

RECENT PUBLICATIONS

BOOKS ON GEOGRAPHY IN THE HOME UNIVERSITY LIBRARY

Many of our readers are familiar with the so-called HOME UNIVERSITY LIBRARY which is being brought out in this country by Henry Holt & Co. Of the fifty or more little volumes that have already appeared, at least a dozen are of direct interest to teachers of geography. Miss

Newbigin's *Modern Geography* would head this list. It has already been reviewed in this magazine (May, '12). Holderness' *Peoples and Problems of India* is one of the most satisfactory books on India which we have read. We reprinted a part of the chapter on The Caste System last month. Mac Gregor's *Evolution of Industry* gives a compact account of industrial evolution, especially in the United Kingdom. It will be useful to teachers of Commercial and Industrial Geography. Bradley's *Canada* and Kiles's *Civilization of China* are largely historical. Bruce's *Polar Exploration* and Johnston's *Opening Up of Africa* are geographical and historical both. Hinks's *Astronomy* and Gregory's *Making of the Earth* are near-geography; both are intensely interesting and give excellent summaries of modern phases of the sciences with which they deal. Several other volumes, e. g. *The Evolution of Plants, The Animal World, Anthropology, Evolution,* are of interest to the geographer because they deal with matters which lie close to the foundations of modern scientific geography. All of the books are new and are written by recognized authorities. Their small size and low price (50c) seem to us to be commendable features.*

DONALD IN SCOTLAND AND JOSEFA IN SPAIN. *Little People Everywhere Series.* By Etta Blaisdell Mc Donald and Julia Dalrymple. About 120 pages each. Published by Little, Brown and Co., Boston. 60 cents each (regular).

These delightful little geographical readers add two more to the series which now numbers twelve in all. "Donald in Scotland" is designed for grades IV or V and "Josefa in Spain" for grades V or VI.

The books are finely illustrated, prettily bound, and the travel-stories which they contain are naturally and interestingly told.

HISTORY OF THE CANAL SYSTEM OF NEW YORK, together with brief histories of the canals of the United States and Canada, issued by the State Engineer and Survey of New York. 2 vols.

This valuable document was issued in 1906, but only recently came to our attention. It is an exhaustive report, bringing together a vast amount of data pertaining to the joint field of geography and history. We do not know upon what terms these volumes are distributed to the public, but doubtless schools and libraries can secure them by payment of transportation charges.

A MANUAL OF SHOEMAKING... Dorley, William H. pp. X + 287. Little, Brown and Company, 1912. $1.50 net.

This volume is the outgrowth of work done by the author in assisting the Lynn, Mass., Commission on Industrial Education in preparing a course of study for the proposed shoe school in that city. It is written

*A full list of the volumes thus far published will be found in the advertising pages of this number of the *Journal*.

"to meet the needs of the industrial, trade, and commercial schools or those who have just entered the rubber, shoe, and leather trades," and without doubt will fulfill its mission. The book is well written and all of the twelve chapters are instructive, though the general public would not find them all interesting. Both the illustrations and the mechanical makeup are good.

A REMARKABLE LAKE

ALMOST peculiar lake is a broad expanse of water and water weeds in Central Africa. Its name is spelled in a variety of ways, *Chad, Tsad, Tchad,* etc. One peculiarity is the fact that on the surrounding wide mud flats the Spheres of Influence of three rival nations meet, Great Britain, Germany and France, thus its waters may reflect the Union Jack, the German Red, White and Black and the French Tricolor.

Lake Chad is situated in the deepest and flattest part of a wide depression, in the borderland between the arid steppes which on the north, merge into the Sahara, and the Land of the Blacks, the wooded Soudan on the south. It is one of the most elastic of lakes, covering five times as great an area in the wet season as it does in the dry. This is so because it is exceedingly shallow, with very flat shores so that even a slight rise in level in the wet season means a great increase of surface; and because the dry season, when it receives the minimum inflow, is also the time of greatest loss of evaporation.

In the eastern part are many islands; but they are connected with each other and with the mainland during part of the year when the channels between them become swampy or dry. It is worth nothing as a waterway; one might say less than nothing, for its shallowness, its variations and its wide expanse of aquatic plants, render it an obstacle to intercourse. There are several tributaries, of which the Shari River flowing in through a wide delta from the South brings most water.

There are other lakes in sinks without an outlet, but they are salt, while Lake Chad is described as a shrinking sweet-water lagoon. Because of its sweet water, some underground leakage is suspected, but has not as yet been determined. In all probability it will continue to shrink, for like other lakes, it is ephemeral in character; the rivers, bringing in new material, are constantly increasing its shallowness; that its existence is a question of but a short time, is doubted by the French officers who are at present engaged in its systematic study. Any one who visits Lake Chad during the period of drought or notes the changes of shore lines or the increase of swamps since 1823 when it was first seen by European eyes, will be tempted to predict a speedy end; remembering, however, that it is the low point of a very extensive basin whose drainage it is bound to receive, it is only reasonable to expect it to remain a lake for a long time.

FREDERICK HOMBURG.